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T R O P I C A L H O U S I N G & P L A N N I N G

M O N T H L Y B U L L E T I N

for Dr. C. A. DOXIADES*

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I. CURRENT LITERATURE

GENERAL

1. Kelly, Burnham, ed. Housing and economic development: a report of a conference sponsored at the Massachusetts Institute of Technology by the Albert Bemis Foundation on April 30 and May 1 and 2, 1953. Cambridge, Massachusetts Institute of Technology. School of Architecture and Planning, Jan. 1955. 161 p. processed.

A reproduction of papers at the Conference. Perhaps of special importance in regard to housing in the tropics are the following: "The importance of housing and planning in Latin America," by Anatole A. Solow, p. 52-58; "Measuring housing needs in underdeveloped countries," by Lloyd Rodwin, p. 67-71; "Housing in a village of India," by Robert E. Alexander, p. 82-92; "Design," by José Luis Sert, p. 93-98; "Housing experience of the Standard Oil Company," by K. H. Quick, p. 99-104; "A study of permanent housing in overseas mining development," by David M. Hansen, p. 105-114; Redevelopment in El Salvador," by George A. Dudley, p. 115-119.

The Solow paper points out tremendous variations in Latin America as a whole, ranging from primitive villages in Ecuador or Guatemala to Sao Paulo, which is a bustling city not unlike Chicago. He points out that housing should come first--not second as many economists would have it--in economic development, believing that high productivity alone does not necessarily mean better living standards. He cites various incidents to substantiate this.

Rodwin's paper points out inadequacy of data collected by UN and their specialized agencies. He lists three ways of measuring housing needs:

> 1) housing which contributes directly to added production or output (directly complementary to development); 2) housing as a consumption good--as a self-justifying human preference; 3) housing for political purposes. Though these criteria are not mutually exclusive, we gain insight by keeping them separate. The first measure is the most sensible from the point of material progress, i.e., raising output. Housers and planners ought not, and I think do not, quarrel with it, especially if they accept this objective. They may think it does not go far enough. But it is a fruitful basis for arriving at a first approximation.

He goes on to say that estimates of need will be a function of policy decisions affecting important components of this housing market, such as slum clearance, existing stock of housing, and location of economic activities.

The Alexander article on housing in a small Indian village describes an instance of technical assistance involving planning and housing, demonstrating the interrelation and inseparable nature of physical and economic planning. His argument is that the problem of housing is an economic one.

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Dean Sert's article on Design makes a plea for housing as part of the community plan, and for housing to suit the needs of the people. He also points out that many new communities are needlessly depressing to look at. He lists as important 1) proportion, 2) color, 3) a design that produces a community and a way of living.

The Quick paper covers briefly housing by the Standard Oil Company in Venezuela, Aruba, Canada, Indonesia, and France.

Mr. Hansen's article describes housing in Venezuela by the Orinoco Mining Company at the new town of Ciudad Piar and Puerto Ordaz, presently being developed. He outlines general principles of site selection and general planning, and then discusses housing design under the following headings: Design of the homes; Tropical climate; Resistance to termites and insect damage; Local labor laws (minimum standards). He discusses use of local materials and states that the region can supply laborers skilled in all types of masonry construction.

The Dudley article describes a plan for rebuilding in a valley in El Salvador after an earthquake destroyed five small towns in the valley. The government's first plan was to build a new town in the center of the destroyed ones thereby depriving people of the only arable land which was in open land center surrounded by these towns. After more thorough economic study it was decided to rebuild on old sites rather than one central one. Housing decided on was as earthquake resistant as possible--a concrete frame, block wall, corrugated asbestos roof, lots of color. These replaced cane huts. Self-help and other subsidies necessary to pay for them.

2. National Planning Association. Technical cooperation in Latin America; organization of United States government for technical cooperation. [Washington], The Association, [May 1955]. 25 p.

A statement by the NPA Special Policy Committee on Technical Cooperation. Report recommends technical cooperation program be returned to Dept. of State and outlines principles under which it should be administered.

A second pamphlet of the same title with sub-title, "Technical cooperation--sowing the seeds of progress," was published in June 1955.

3. Page, J. K. Preliminary note on the design of buildings for air conditioning in the tropics. (In Journal of the Royal Institute of British Architects, Jan. 1955, vol. 62:3, p. 102-108; with photos., plans, diagrs., charts, tables.)

As title indicates it is concerned with design factors for air-conditioned building in tropics. As such probably of limited interest to one concerned with low-cost housing, but points made as to reducing heat generally probably of interest.

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Subject covered under headings: Selection of site in relation to services (source of water, etc.); Desirable features of site (shaded sites, for example); Orientation (especially so as to reduce solar heat, and where possible an east-west axis for building); Space standards; Ceiling heights; Location of cooling plant within building; Infiltration of air through openings.

Under heading "Control of heat from outdoors," subject discussed under following sections: Reducing the exposed roof area; Using a light-colored surface finish on walls and roof; Ventilating the roof space; Insulating the roof-ceiling structure; Shading the walls; Providing walls of high thermal resistance of sufficient thermal capacity; Reducing heat gain through windows.

There is included a table of percentage of diffuse solar radiation absorbed by various types of surface. Table 2 shows suitability of different types of insulated and uninsulated roof-ceiling construction for air-conditioned buildings in the tropics. Table 3 shows suitability of different types of insulated and uninsulated wall constructions for air-conditioned buildings. Tables 1 and 2 are reproduced here.

Table 1. Percentage of diffuse solar radiation absorbed by various types of surface

	Per cent
Asbestos cement, new	42-59
Asbestos cement, very dirty (six years U.K.)	83
Bituminous felt	86
Bituminous felt with aluminised surface	40
Clay tiles, red	62-66
Galvanised iron, new	64
Galvanised iron, very dirty	92
Galvanised iron, whitewashed	22
Paints, white	18
Cellulose, dark green	88
Cellulose, dark red	57
Cellulose, black	94
Slates, dark grey	90

Table 2. Suitability of different types of insulated and uninsulated roof-ceiling constructions for air-conditioned buildings in the tropics

Section I. Pitched roofs with insulated ceilings

In most areas lightweight roof coverings like galvanised iron, asbestos cement or aluminium sheeting are used, and tiles will be available at a competitive cost only in comparatively few places due largely to high cost of transporting heavy materials over big distances. Examples of tiled roof structures have been set forward in this table, as U-values were readily available. Though it is possible to compute U-values for other types of construction, any extra work was not felt to be justified, in view of the very limited significance of the winter U-value concept under tropical conditions of downward heat flow.

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Table 2. (Continued)

(U-values measured or computed for English winter conditions are given in brackets.)

Corrugated asbestos without ceiling (1·40) . . . . . .Very poor
Corrugated asbestos, one sheet of aluminium foil insulation 1 in. below sheeting (0·50). . . . . .Poor
Corrugated asbestos, two sheets of aluminium foil insulation, 3/4 in. apart and 1 in. below sheeting (0·25) . . .Not good
Tiles on battens and felt (0·70) . . . . . .Poor
Tiles on battens, boards and felt, lath and plaster ceiling (0·28). . . . . .Not good
Tiles on battens and felt with 1-in. corkboard ceiling plastered (0·17). . . . . .Fairly good
Tiles on battens and felt with 2-in. woodwool slabs on ceiling plastered (0·18). . . . . .Fairly good
Tiles on battens and felt with 4-in layer of glass wool, rock wool, slag wool, or expanded vermiculite above ceiling boards (0·08) . . . . . .Very good
Tiles on battens and felt with 4-in. layer of insulation as above with a layer of aluminium foil to reflect infra-red radiation on top (less than 0·08) . . . . . .Excellent

Section II. Flat roofs. (Winter U-values taken from A.S.H.V.E. Guide given in brackets)

Asphalt on 6-in. concrete (0·65) . . . . . .Very poor
Asphalt on 6-in. concrete lined with 1-in. cork and plastered (0:21). . . . . .Not good
Asphalt on 6-in. concrete lined with 2-in. cork and plastered (0·12). . . . . .Good
Asphalt on 6-in. concrete with inner ceiling (lath and plaster) (0·37) . . . . . .Rather poor
Asphalt on 6-in. concrete with inner ceiling 2-in. corkboard (0·11). . . . . .Good

(The value of slabs raised on blocks about 3-in. from the main roof structure should be borne in mind as an effective way of reducing the heat load on the roof.)

4. United Nations. Economic and Social Council. Financing of housing and community improvement programmes: Report by the Secretary-General. New York, United Nations, Mar. 7, 1955. 100 pages. mimeo. (Social Commission, Tenth Session, Item 7 of Provisional Agenda.) (E/CN.5/307.)

Chapter II covers Asia, and Chapter III, Latin America and the Caribbean area. Chapter II. Housing in arid and humid climates costs equivalent of approximately $1000 to provide family with minimum housing. Rental or purchase cost is about $10 per month and on the basis of 15% to 20% of income on housing, requires income of $50 to $70 per month. Income data incomplete but probably only 10% to 30% of households have such income.

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Housing chiefly by private enterprise. Building and Loan Societies and Housing Cooperatives have had little influence. Financial institutions giving long term credit hardly exist--except for few mortgage banks in the Philippines and Government Savings Bank in Thailand.

Chapter ends with section, "Conclusions," as follows:

CONCLUSIONS

70. The principal conclusions that arise from the study are as follows:

a. A balanced development programme requires a housing component. This is especially the case in Asia where there is a structural change in society involving considerable movement from rural to urban communities. Expansion of other productive capacity and the need for mobility of labour cannot ignore the complementary need for housing. As a matter of fact, much of the saving for housing is so tied up with the household interest in better dwelling that it cannot be transferred to other uses until urgent needs are met. Large groups of population will save for housing but would not save otherwise. Moreover, economic growth requires balanced capital formation if increased production is to be absorbed. Thus, apart from its social desirability, housing has an important function in economic development, both to strengthen the savings habit, and to stimulate the productive use of the savings.

b. To strengthen its function requires a broad approach to the problem of housing rather than concentration on special phases such as industrial housing alone.

c. Governments - central, state and local - must take an important part:

(i) To provide additional funds to establish a national housing finance corporation, expand building and building materials industries; to provide resources for land acquisition, water, drainage and sanitation, and to subsidize the cost of housing for low income people; to seek these funds in part through special measures to supplement government savings by inducing additional private savings.

(ii) To strengthen other financial institutions, including insurance companies, savings banks, building and loan societies and co-operatives; to stimulate the channelling of a part of their resources into housing, and possibly to encourage use of some time savings of commercial banks for long-term finance.

(iii) To provide incentives to employers to increase their financing of housing through such devices as accelerated depreciation allowances, or treatment of housing costs and receipts as part of regular business expense and income.

(iv) To revise land acquisition laws to permit more economical and speedy procurement of land for housing and to strengthen urban and regional planning in order to minimize wasteful use of resources.

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d. Even with austere standards, needs are so great that government funds alone can never cope with the housing problem. The main challenge in the use of public funds is to combine them effectively with other incentives and to stimulate more intensive individual and enterprise effort.

e. A principal additional contribution to finance of housing in Asia can be an increased amount of aided self-help, not simply in rural areas but particularly in urban and suburban land development and housing construction.

f. The principal financial resources for improved housing, however, must be the current household income. For new construction, housing payments must be greatly in excess of 10 per cent of household income if there is to be any opportunity for low-income families to secure improved housing on a wider scale.

g. Government must provide some of the initial capital needed for construction. It can also subsidize the costs in various ways - for example by reductions in interest rates, increase in amortization periods, outright grants, or loans combined with grants. The difficulty for the government will be to decide how to secure that combination of self-help and increased financial contribution from the family that will, along with the government contribution, provide resources needed. The extent to which an increased volume of housing can be achieved will depend on the skill with which this responsibility is discharged.

h. Within the housing field priorities depend on many considerations, including the present condition of housing, the inflationary or deflationary position, eagerness of the people themselves to improve environmental hygiene and comfort, administrative skills available and the like. The present facts in Asia with regard to such considerations would suggest top priority to the following:

(i) Establishment or strengthening of financial institutions for long-term housing finance and stimulation of self-help.

(ii) Planned and economic land acquisition for urban and sub-urban housing.

(iii) Improvements in water supply, sanitation and drainage.

Chapter III covers Latin America and the Caribbean area. Population growing at the rate of over 2% annually and urban population rate even greater. 80% of existing houses in need of repair or replacement. 30-year program estimated to require about 1.2 million dwellings annually of which one half is in rural areas, in addition to major repairs for old houses. The following is quoted from "Conclusions" at end of chapter:

Conclusions

120. The following conclusions and recommendations concerning financing of housing in Latin America were reached by the Ad Hoc Committee for the Study of the Low-Cost Housing Problems convoked by the Inter-American

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Economic and Social Council at a meeting at the Pan-American Union in September 1953[1/] and approved by the Inter-American Economic and Social Council on 24 November 1953.

Financial resources for housing

121. Considering the great discrepancy that exists between the relatively small amount of what is being invested in housing of social interest, and the amount actually required to meet the present need, the following questions arise: Can this difference be reduced? To what extent? By what means? The following conclusions have been reached in this respect:

(a) In considering the financing of housing in each country, its social needs as a whole and its financial possibilities should be taken into account.

(b) Within the overall limitations of present total resources, consideration might be given to the following means of augmenting financial resources for housing of social interest:

(i) By improving the efficacy of existing financial institutions and thereby making existing funds go farther in providing housing of social interest.

(ii) By a redistribution of consumer expenditures, channeling the socially less desirable part of such expenditures into savings for the specific purpose of investment in housing of social interest. In this respect it should be noted that there are greater psychological incentives in saving for a home than for any other purpose.

(iii) Through a redistribution in the general investment pattern by channeling more capital into construction of housing of social interest and less into the production of certain other items that are less important in the social and economic development and well-being of a country.

(iv) Through a redistribution of general building investments and housing investments in particular, by channeling more into housing of social interest instead of into other types of luxury construction.

(v) By considering in all financing of social interest the financial participation of the municipalities in the costs of development of land and utilities.

(c) It is recognized that such a redistribution as suggested above will have better results if carried on within such limits as will not harm the general economic development and balance.

1/ See Problems of Housing of Social Interest: Report prepared by the Ad Hoc Committee for the Study of Low-Cost Housing, Pan-American Union, 1953.

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(d) Although at present, without deep study, the limits cannot be completely defined and therefore the additional amount that can thus be made available for housing cannot be determined, it is believed that:

(i) Such limitations will not make possible the channeling of all the necessary funds into housing of social interest.

(ii) Substantial additional amounts can be obtained, thus reducing the deficit (i.e., the discrepancy between the need and the present amount being utilized in housing) to a significant degree.

(e) With reference to institutional means for the financing of housing, the following conclusions have been reached:

(i) When private and semi-official institutions invest their reserves and savings in the construction and financing of housing of social interest and mobilize credit for housing, they have tended to further the economic development of their countries.

(ii) Private institutions have not played an important role in the financing of housing for low-income families. However, savings and loan institutions fortuitously serve some families of the upper reaches of the low-income group for whom the ownership of housing is socially and economically possible. On the other hand, the large-scale operations of some mortgage banks with a high degree of governmental participation, would allow them to serve the housing need of low-income families to a much greater extent in the future.

(iii) Semi-official institutions, and particularly social security institutions and official mortgage banks, in contrast to private institutions, have given increasing attention to the solution of the housing problem of the less favoured economic groups.

(iv) The Latin American institutions that promise greatest possibilities of success with relation to the financing of housing for some of the low-income families and a large part of the middle-income families are:

mortgage banks
savings and loan banks and associations
social security agencies
housing co-operatives.

(v) Owing to the general scarcity of financial resources for housing, the cost of money and credit are still much too high. The efficiency of most institutions of this type could be greatly increased and financing costs reduced even more.

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(vi) The magnitude of the financial efforts directed by the Governments toward the solution of the housing problem bears practical and clear testimony to the fact that the Governments understand their responsibility. However, a more extensive solution to the problem would require greater participation by the State, and the various countries would have to determine how much could be invested in housing in relation to other national activities. At any rate, it should be pointed out that public expenditures for housing of social interest are not necessarily irretrievable.

(f) The following economic, social, legal and administrative measures would increase the general availability of funds for housing of social interest:

(i) Encouraging the investment of private capital in the construction of housing of social interest through sound monetary, banking and fiscal policies.

(ii) Redefining the policy on interest on capital so as to encourage banks and private capital to invest in the construction of housing of social interest. Moreover, it is necessary to seek procedures for insuring these investments and attracting capital, such as exemptions or reductions in taxes, registration fees, and other levies on new buildings.

(iii) Providing for special types of credit for effecting structural repairs and improvements in dwellings occupied by low- and middle-income families so as to prevent the type of situation that requires the establishment of rent-control laws.

(iv) Preparation of regional plans for the development of agriculture, industry and mining, as well as the preparation and application of Master Plans for urban and metropolitan areas, will be a great help in overcoming many of the difficulties faced by the Governments and agencies charged with finding the financial and technical means for solving the housing problem.

(v) The so-called Land Reserves, the acquisition of land located close to urban areas or in their environs, practised under authorization by the Government, to prevent private speculation, has given gratifying results wherever it has been practised, since the result has been to lower the cost of land and therefore of housing, and also to prevent an anarchy with respect to improvements that would be both dangerous and costly.

(vi) Encouraging the co-operative movement for housing through the following methods:

Legislation that will encourage, by exemption from taxes, construction of housing through the co-operative system and encourage the establishment of

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national housing co-operatives that will contribute to the centralization of activities in order to facilitate technical direction.

Loans to co-operatives by government agencies, especially those set up to promote housing of social interest, and the establishment of national co-operative banks.

Establishment of building co-operatives, to be subsidiaries of the housing co-operatives and members of the national federation of housing co-operatives.

Exchange of services through the federations with a view to lowering the cost of materials and labour.

Guidance of urban and rural housing co-operatives, so that the members will be able to participate physically and technically in carrying out work and preparing building materials (self-help and mutual-aid system).

(vii) Amending the laws that prevent banks, insurance companies, and other financial institutions from investing their capital in housing of social interest.

(viii) Seeking procedures whereby the Government would insure mortgages secured by loans on low-cost and medium-cost housing, which would tend to reduce the risks of investors and, therefore, attract more private funds for such investments.

(ix) Consideration by the Governments of expanding credit to institutions that engage in the construction of housing of social interest, provided that this measure does not increase inflation or interfere with the normal economic and social development of the country.

(x) Encouraging the expansion of the building industry and expanding the production of building materials and structural components by authorizing the granting of governmental loans or other financial measures.

(xi) Establishing funds for direct subsidies for housing of social interest through specific taxes or other sources of public funds.

(xii) Creating a National Housing Agency wherever this has not been done, as recommended in Resolution 10/53 of the Third Extraordinary Meeting of IA-ECOSOC. Such an agency should be responsible for analysing the overall housing needs of the country and obtaining the resources available for dealing with the problem. Thus the agency in question will be able to mobilize the financial resources, both official and private, to meet the needs effectively. In

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some situations the Government will merely establish the appropriate conditions for the successful operation of private financial activities; in other cases the Governments will participate, either directly or indirectly, in financing housing with governmental guidance, guarantees or public funds. The National Housing Agency should also be responsible for helping to organize and co-ordinate the various governmental and private operations that are directed to the improvement of the housing situation. The Government will stimulate communities to analyse and solve by themselves most of the problems, calling upon the central or the state governments when necessary.

(xiii) Take the necessary measures to increase the efficiency of housing agencies, such as:

centralization of operations
organization of the administrative set-up
larger-scale operations.

5. United Nations. Economic and Social Council. Social Commission. Progress made by the United Nations in the field of social welfare during the period 1 January 1953 - 31 December 1954, and proposals for the programme of work 1955-57. Report of the Secretary-General. [New York], United Nations, Mar. 15, 1955. 128 [17] p. tables. (Distr. General E/CN.5/308.)

Chapter IV, Part 3 contains the following sections: a, Housing conditions and programmes. In this section mention is made of the housing survey on Housing and Building Materials in Asia and the Far East prepared by ECAFE, which organization is also collecting data on housing standards. It also refers to a report on international definition and measurement of standards and levels of living prepared by United Nations, ILO, and UNESCO (E/CN.3/179-E/CN.5/299). It also refers to a special chapter on housing in the International Survey of Programmes of Social Development which records findings of a preliminary study made in 1953-54 on methods and techniques of formulating housing programs. The code number of this International Survey etc. is E/CN.5/301.

Section b. is entitled Extension of housing for low-income groups, and tells of the U.N. Regional Seminar on Housing and Community Improvement, of the International Exhibition on Low-cost Housing, organized by the Government of India with participation by other governments of the region as well as of building industry, and of a Seminar on Housing through Non-Profit Associations.

Special emphasis on more effective integration of building research with social and economic research in housing and planning lent support to proposal for establishing two regional housing centers under guidance of ECAFE, in co-operation with Governments concerned, and with assistance of the U.N. and interested specialized agencies. Accordingly plans have been worked out with governments concerned to establish during 1955-57, one such center in Indonesia to deal with questions arising in hot and humid tropical countries. Main task will consist of co-ordination of studies, research, etc.

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Section 2, Financing of housing, refers to government attempts to supply adequate housing at low cost. It refers to U. N. report, "Financing of housing and community improvement programmes," (E/CN.5/307) which is noted elsewhere in this letter.

Section 4, Building and building materials industries, records that the Economic Commission for Asia and the Far East is proposing to review the adequacy of plans for developing the building and building materials industries with particular reference to increasing their capacity to deal with dwelling and other types of construction works, and that the Organization of American States has dealt with the building industry in relation to Latin American problems and ECLA has included the subject within its country studies on economic development. The Secretary-General proposes during 1955-57 to use practical results of these studies in rendering direct assistance to governments and in cooperating with regional housing centers.

6. White, Robert F. Landscape development and natural ventilation: effect of moving air on buildings and adjacent areas. (In Landscape architecture, Jan. 1955, vol. 45:2, p. 72-81; with photos., plans, sketches, tables.)

Article herewith, in Part III, in its entirety.

7. Wiener, Imanuel S. Solar orientation: application of local wind factors. (In Progressive architecture, Feb. 1955, vol. 36:2, p. 112-118; with diagrs., tables.)

Up to present, when orientation of building considered, solar radiation has been main climatic factor determining orientation. Up to present the "prevailing wind direction" only wind factor considered. Corrections of undesirable wind factors done mainly by windbreaks, planting, etc. Such have no effect on upper stories of tall buildings. Very little has been done to take advantage of desirable wind effects during hot season.

8. Your house next summer can be 20% cooler without air conditioning. (In House and home, Feb. 1955, vol. 7:2, p. 140-143; with photos., plans, cross sections.)

A popular article using a few "old tricks." Hole in roof to let hot air escape and create a flue action; a "venturi" blow-through, air scoops, ventilated roof and a make-it-yourself breeze. The "venturi" principle consists of taking air in through big openings and funneling it out through small openings, speeding up air movements. Ground level air taken in has been cooled by trees and shady lawn.

I. CURRENT LITERATURE

HOT DRY AREAS

9. Banks, R. L. Notes on a visit to Kuwait. (In Town planning review, Apr. 1955, vol. 26:1, p. 48-50; with photos., map, plan.)

Population: 90,000

Climate: circa 123/19° F

Rainfall: circa 7"

A general description of the conditions in Kuwait, where finance presents no problems. A small and rather isolated community can order almost whatever it wants from Western world. Article describes its favorable economic state, and its development plans. Community has many excellent schools, a central kitchen for school children, and a large technical college.

In spite of prosperity and a benevolent ruler there are no housing estates. Population growing at great rate but new population lives in matting huts or oil can shanties or occupied "bed space" in center of old towns.

10. Fry, E. Maxwell. Chandigarh: the capital of the Punjab. (In Journal of the Royal Institute of British Architects, Jan. 1955, vol. 62:3, p. 87-92 discussion, p. 92-94; with photos., plans, sketches.)

Population: circa 50,000

Climate: 84/55° F

Rainfall: 30"

An historical sketch of activities from the beginning in the development of this new town. The city plan, though a master plan had originally been made by Albert Mayer, as it emerged after combined effort of whole group owes most to Corbusier.

There follows discussion of the city plan, the financial pattern, and finally the design of the houses and the techniques involved in their building.

Since this whole development is so well known perhaps a detailed summary of this article is not necessary.

11. Gilead-Gromet, S. Israel scrapbook. (In Architectural review, Feb. 1955, vol. 117:698, p. 121-128; with photos.,map. Climate: circa 108/25° F Rainfall: circa 25"

Israel an immigrants' country where there appears an almost total rejection of traditional styles. Since 1948, 200,000 persons per year pouring in needing homes. Population doubles in three years. Housing of existing population already acute--shortage of dwellings and building materials.

Another task, planning and replanning of entire areas. Planning Dept. set up. Detail planning and most of planning in small cities, however, mostly done by private planners and architects.

Dwellings erected to meet immediate need were of low standard and rented at low rate. Lately Government policy is to provide decent dwellings at reasonable price--called "Popular Housing." Most now under government departments.

Variety of climatic conditions in Israel (coastal plain Mediterranean climate, hills of Galilee and Judean hills cool and dry, Dead Sea region sub-tropical heat, Negev region desert conditions), reflected in type of building.

Little done in insulation. Great majority of buildings have walls 8 to 9 inches thick, in concrete blocks or bricks. Floors are concrete slabs covered with cement tiles. Flat reinforced concrete roofs insulated only with whitewashing.

Reinforced concrete is common type of construction in Israel--even the non-bearing members of structure are often poured in concrete in spite of poor insulation qualities. Only widely used material for walls are various kinds of concrete blocks and silicate bricks. A handicap of building is lack of tradition in workers employed.

There is restricted use of color in buildings, partly because usual types of lime paint fade in strong light.

There follow six pages of illustration with very brief descriptive text of architecture in Jerusalem, Tel-aviv, Haifa, Beersheba.

The article ends with a description of the two types of land settlement in Israel;--the Moshav and the Kibutz. In the former members' individual and

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private lives independent but activities in earning a living controlled by community. In the latter there is further communal control; they have communal kitchens, dining halls, nurseries, laundries, etc. These two ways of living demand new types of buildings.

12. Guth, Pierre Jean, and Jacques Sergent. Cité residentielle à Oran, immeuble de 300 logements. (In L'Architecture d'aujourd'hui, Feb. 1955, vol. 26:58, p. 88-89; with photos., plans.)

Population: 6834
Climate: circa 112/28° F
Rainfall: circa 27"

Dar Beida, "Maison Blanche" situated on the southeast edge of the Oran are between Oran and Algiers, on the route to LaSénia airport. Described and pictured is the first building of new town projected by La Marine Nationale for the military and civil personnel of the establishments at Oran.

Brief text and illustrations descriptive of the apartment building.

13. Housing project planned for India's mill workers. (In Foreign commerce weekly, May 16, 1955, vol. 53:20, p. 29.)

Climate: circa 120/29°
Rainfall: circa 17"

German city planners "reported to have been requested by the Government of India to help build a modern housing project for workers in an underdeveloped region in northern India." Project to supply housing for families of 15,000 workers who will be employed in new steel works to be built at Rourkela. New town to be on plain almost clear of habitation.

14. J[illegible]tin, Joel B., and Khalil Taleghani. Iran develops its rivers: modern dams replace ancient structures and activate new projects, mainly for irrigation, but also for power and flood control. (In Civil engineering, Mar. 1955, vol. 25:3, p. 49-53; with photos., map, plan, cross-sections, table.)

Climate: circa 85/63° F
Rainfall: circa 10"

75% of people live on land and dependent on agriculture for livelihood. Irrigation Dept. implemented studies of river projects. Completed

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projects: Kohrang Tunnel, Sistan Project, Akhatekhan Dam, Karadj Dam, Karkheh Project, and Doroodzan Project. Several others under investigation but final plans not yet made. They include the Sefid-Roode, Karun River, Saveh, and Zarrinah-Roode Projects.

15. S. Rhodesia to build new low-cost homes. (In Foreign commerce weekly, May 16, 1955, vol. 53:20, p. 29.)

Climate: circa 102/30°F

Rainfall: circa 29"

Plan announced by Provincial Government provides for 6000 houses, half in Salisbury and half in Bulawayo, to cost £ 2 million. It provides for purchase of homes by Africans under 99-year leasehold with payments amortized over 15, 20, or 25 years at 5%. On basis of 20 years, payments average about £ 2 per month, and a further charge of £1 per unit would cover, water, sewerage, and all public services.

Homes needed because of industrial expansion in urban areas.

16. Sanchez, Félix. Le problème de l'habitat populaire à Mexico. (In L'architecture de'aujourd'hui, Apr. 1955, vol. 26:59, p. 59-62; with photos., plans, diagr.)

Population: (Mexico City) 2,233,700

Climate: 92/24° F

Rainfall: 29"

Article describes Mexican housing finance and organization, especially the work of the Banque Nationale Hypothecaire Urbaine et de Travaux Publics which as a central office is the promoter of planned developments. Private institutions may then finance the houses on the lots, subject to certain rules of density, design, etc.

There follow plans, either descriptive notes, of several of these "Unités Résidentielles."

I. CURRENT LITERATURE

HOT HUMID AREAS

17. Ceylon plans 6-year housing program. (In Foreign commerce weekly, Apr. 11, 1955, vol. 53:15, p. 25.)

Climate: circa 97/62° F
Rainfall: circa 80"

Ministry of Housing reported to have outlined plans calling for 25,000 houses a year between Oct. 1955 - Sept. 1961, to cost 50 million rupees (U.S. $10,500,000). 6000 houses in rural areas to be built yearly, using domestic materials to extent possible. Estimated 144,882 new houses needed in urban areas, about 50% of which needed for families unable to pay a monthly rental of more than 20 rupees ($4.20 U.S. dollars). They hope to build approximately 3600 low-cost houses yearly for these. Imported cement to be used until Goverment factory is able to increase output.

Ministry interested in prefabrication of building components especially where local material used, but importation of prefabrication not likely to be any less expensive than use of traditional materials.

18. "Houses for Korea": good will project seeks to provide 1000 homes and get Koreans building. (In Engineering news-record, May 19, 1955, vol. 154:20, p. 23.)

Climate: circa 100/10° F
Rainfall: circa 47"

Plans for the American-Korean Foundation, Inc., and the National Association of Home Builders' project to cost 1.5 million dollars, announced. Gen. James A. Van Fleet, honorary chairman for project, says Korean government has promised cooperation; it will provide site in Seoul, and expedite legal clearances required by a non-profit housing development.

William Zeckendorf conceived the program and developed plans in consultation with U.S. and Korean architects. Plans call for 500 single or duplex dwellings and a like number of multi-story apartments.

(Continued)

At present no large-scale building in Korea and it is hoped this will serve as pump-priming.

NAHB and the Foundation trying to get pledges of money and materials.

19. Neighborhood group [Rio de Janeiro]. (In Progressive architecture, Aug. 1955, vol. 36:8, p. 104-109; with photos., plans.)

Population: 2,366,000

Climate: 102/52° F

Rainfall: 43"

Description of city-financed neighborhood group for housing of municipal employees. The development is self-sustaining, with own nursery and elementary schools, swimming pool, market, health center, club house, etc.

The project is made up of a long curved apartment building at top of hill, dominating the development, and several smaller rectangular buildings. The major building is 826 feet long.

Reinforced concrete frame has been used throughout, in combination with brick, left exposed in parts. "Striking color accents and the masterful landscape design of Burle-Marx give unity to the while."

The architect is Affonso Eduardo Reidy, Rio's chief city architect.

III. SPECIAL ARTICLES

White, Robert F. Landscape development and natural ventilation: effect of moving air on buildings and adjacent areas. (In Landscape architecture, Jan. 1955, vol. 45:2, p. 72-81; with photos., plans, sketches, tables.)

LANDSCAPE DEVELOPMENT AND NATURAL VENTILATION

EFFECT OF MOVING AIR ON BUILDINGS AND ADJACENT AREAS

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Texas Engineering Experiment Station
The Texas A. and M. College System
Member, American Society of Landscape Architects

THAT landscape design is not merely a decorative art, but has a firm foundation in science as well as art, is not always a recognized fact. The investigations described in this report serve, in a small measure, to emphasize the importance of landscape design as a science. They should prove to be of value to the layman and professional alike and should be of particular interest to the architect, builder, engineer, nurseryman, and landscape architect. These investigations also stress the very definite significance between a structure and what happens beyond that structure in terms of landscape development.

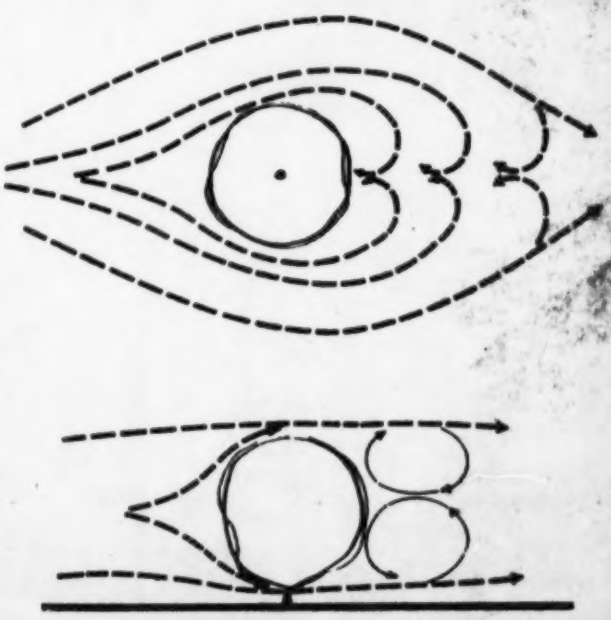
This work constitutes a part of a comprehensive study of how to make the best use of natural light and air in the design of buildings and adjacent areas, which has been under way for some time at the Texas Engineering Experiment Station. Previous publications resulting from the research were concerned primarily with the relation of the structural design of a building to both the distribution of natural light throughout and the pattern of natural air movement through its interior.[1,2*] The present report is concerned with problems of air movement in the immediate surroundings of a single structure. The principles involved may, of course, be applied to other situations as well.

The primary objective of the landscape phase of the over-all study is to determine by specific tests how landscape design elements, including plant materials (trees, shrubs, vines, etc.), walls, fences,[3] and other structures affect air movement. Only a limited number of planting combinations have been studied to date. The premise on which the studies are based is that of human comfort, and interest is not limited to outdoor living alone, but is critically concerned with the effect which planting has upon air movement through the building as well. Plants can enhance a structure only in proportion to the extent they make it more livable.

The fact that a vertical barrier placed perpendicular to the breeze has a pronounced effect upon the movement of air about the barrier is well established. The area affected depends on the height and width of the barrier as well as its composition. This knowledge has been used to man's purposes for many years. The protection afforded to animals as well as humans by shelter belts is well known.[4,5] It appears logical in the chain of human events that man should first concern himself with protective devices against the most severe conditions,—in this case, the reduction in the severity of cold winter winds. Since the shelter belt principle will work in any location, if care is not exercised it may work against man's comfort rather than toward it. The vertical barrier may eliminate the very desirable cooling breezes during the warm season. Basically this report is concerned with methods of making the desirable breeze work toward increasing human comfort.

The problem therefore resolves itself into one of determining the effect of air movement on individual land-

Figure 1



Originally issued in March 1954 as Texas Engineering Experiment Station Research Report 45, and reprinted here by kind permission.

*See bibliography.

Figure 2. Breeze pattern around a "landscape moss" model

Photographs by courtesy of Texas Engineering Experiment Station

Roland Chatham, Photographer, Bryan, Texas

scape elements and arrangements of these elements as they relate to buildings. The study is especially applicable to hot, humid areas where human comfort depends so completely on evaporation from the skin in the natural cooling processes.

The validity of using models for testing light and air movement within buildings was proved in Research Reports 21, 25, and 26 of the Texas Engineering Experiment Station.[1,2,6] The final section of this present report includes substantiating data to prove the usefulness of model tests in outdoor situations as well.

Figure 1 shows the air stream pattern about a solid paper model of a round-form tree, while the photograph in Figure 2 shows the pattern about the "landscape moss" model. These tests led to the conclusion that:

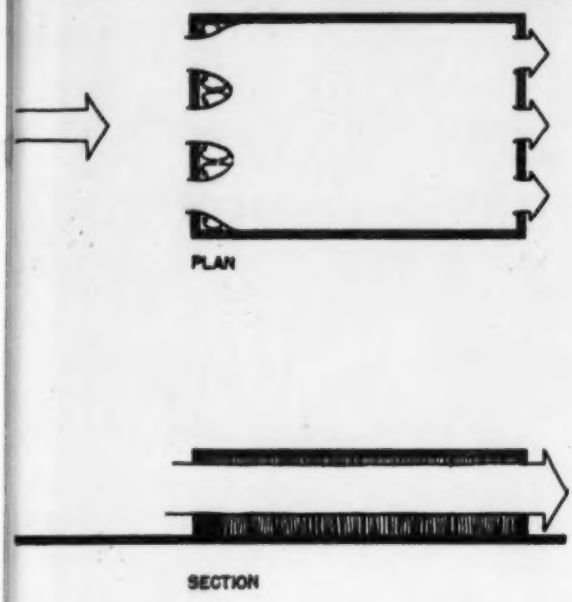
1. The foliage mass of a tree serves as a direct block to the passage of air.
2. The speed of the air movement directly underneath the tree was measurably increased with respect to speeds at stations of the same height on the lee and windward sides of the tree.

Air Movement Patterns Produced by Various Planting Combinations

As a result of the air flow tests run on model trees and shrubs and the verification of the patterns thus established by actual field tests, a series of studies of the effect of location of planting in relation to air flow patterns through a simple structure was undertaken. Although nearly one hundred situations were tested, they represent only the more obvious possibilities. They do, however, furnish evidence that:

1. Planting can materially affect the movement of air through and about buildings.
2. Depending on the way it is used, planting may either augment or reduce the natural air flow through the building.
3. Planting may cause actual change of direction of air flow within the building.
4. Planting on the lee side of buildings has little or no effect on the movement of air through the building unless it is in such a position that it obstructs the outlet openings.

The building and plant models used were at scale of $\frac{1}{4}$ inch = 1 foot. The tree models were constructed of "landscape moss," as were the individual shrubs. The



hedges, made of sponge rubber, were somewhat less representative of natural plant materials, inasmuch as they permitted no penetration of air. Assuming, however, that the hedges were broadleaved evergreen plants of vigorous compact growth, the slight air penetration would not be sufficient to make any significant change in the patterns established by the model material.

Illustrations on the next few pages show some of the situations tested to date.

Hedges

Low, medium, and high hedges in various positions as related to the air inlet openings in a simple structure are shown. Figure 3 depicts the air flow through the structure without planting, while Figures 4 through 13 show the air flow patterns for the various situations tested.

In figures 11, 12 and 13, as hedge is moved farther from the building the air pattern approaches its original state as when no planting existed.

Shrubs

Figures 14 and 15 illustrate medium and high specimen shrubs in various positions as related to the air inlet openings of the study structure.

When the shrubs are moved five, ten, fifteen, and twenty feet from the building, they cause a diminishing downward air flow into the building, and an eddy reaching to the building occurs behind the shrubs. The eddy to the building disappears and the air flow through the building becomes normal when the shrubs are moved to a distance of twenty-five to thirty feet from the building.

Figures 4, 5, 6, and 7. Low hedge (less than three feet high).

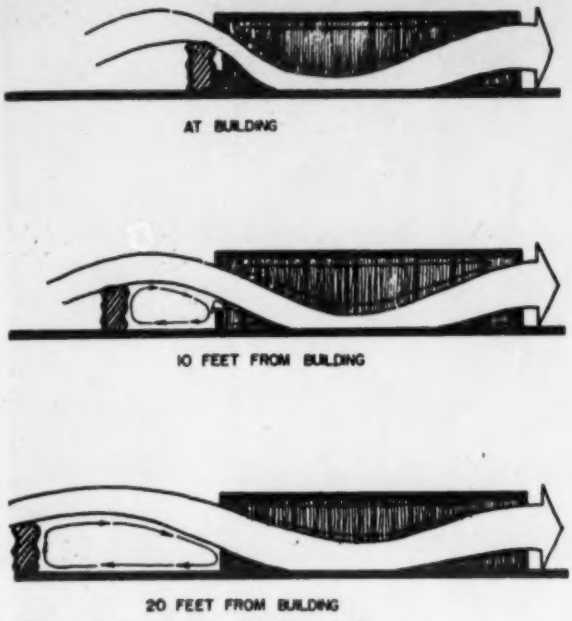
Figure 3. The natural air flow pattern of the test model with no planting.

Trees

Figures 16 through 18 illustrate a 30-foot-high tree, or trees having a 25-foot spread and approximately 5-foot-high branching. The trees have been located in various positions as related to the air inlet openings in the study structure.

Hedge-tree Combinations

Figures 19 through 32 illustrate a 30-foot-high tree in combination with low, medium, and high hedges located in various positions as related to the air inlet openings of the study structure.

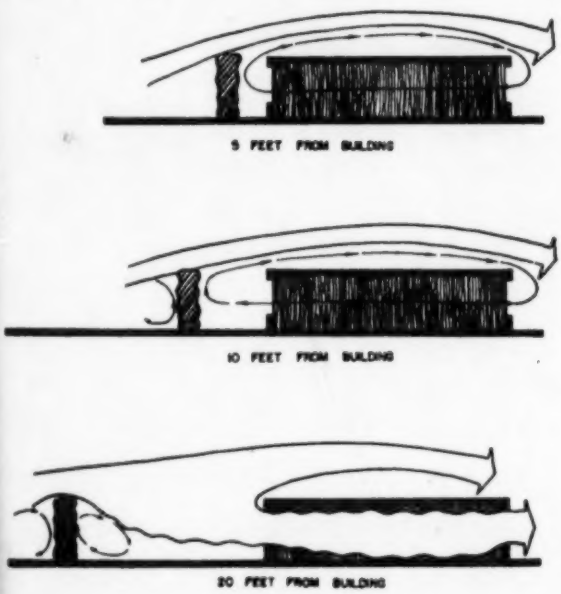


Figures 8, 9, *and* 10. *Medium hedge*

Hedge-building Combinations

Figures 33 through 38 illustrate medium and high hedges located in various positions as related to the air inlet openings of the study structure which has been oriented with no openings on the windward side.

Figures 11, 12, *and* 13. *High hedge*



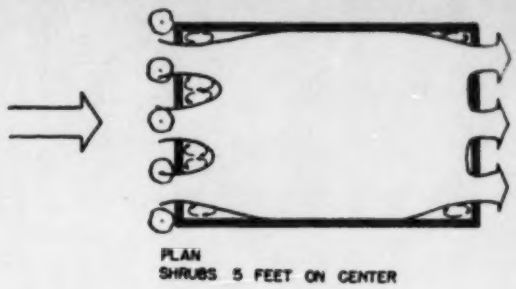


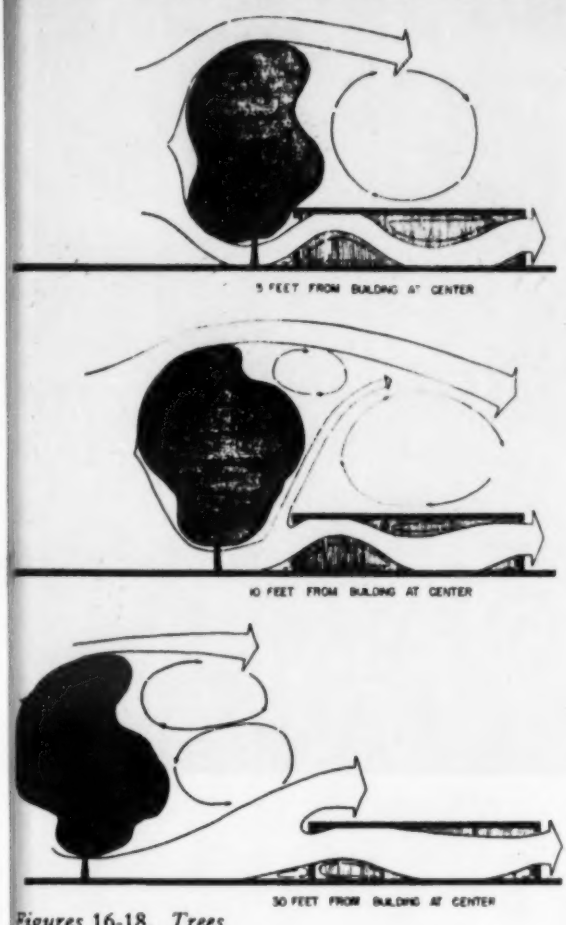
Figure 14. *Shrubs*

Figure 15. *Shrubs*

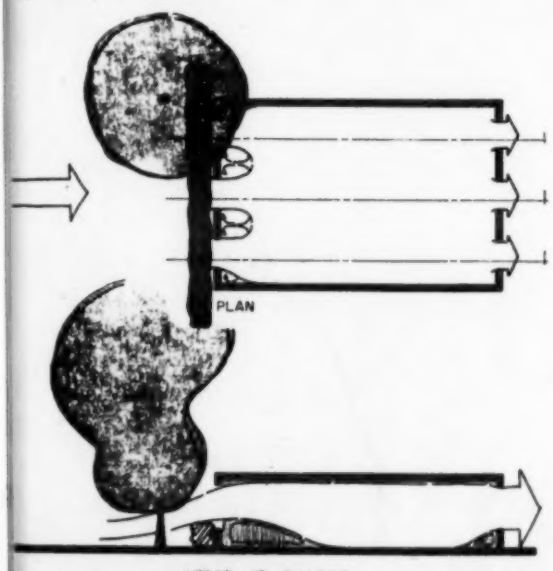
Tree-hedge-building Combinations

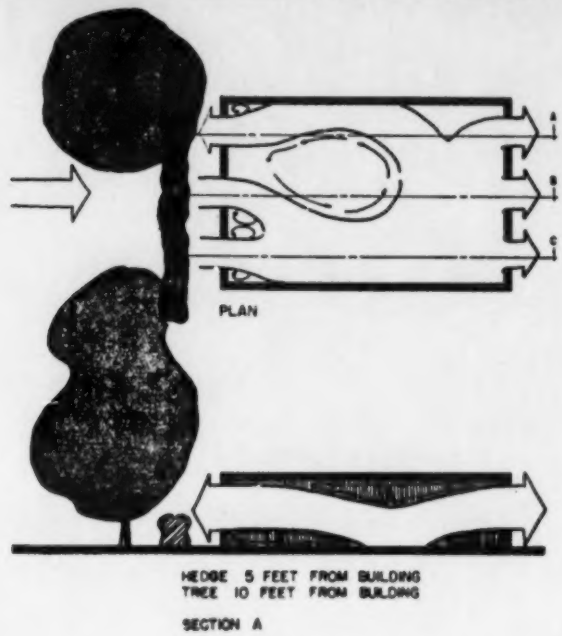
Figures 41, 42, and 43 illustrate medium and high hedges in combination with 30-foot-high trees located in various positions as related to the air inlet openings of the study structure. The structure has been oriented with no openings on the windward side.

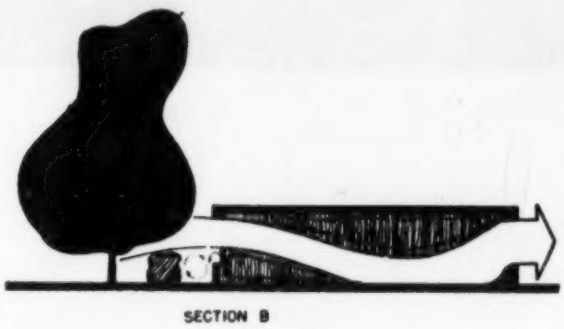
As the result of model tests, field tests to serve as substantiating data were made by measuring air speeds about free standing trees. The methods and results are shown in the following charts and diagrams.

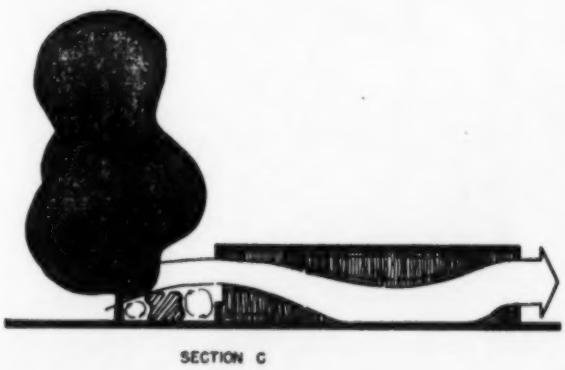


Figures 16-18. *Trees*

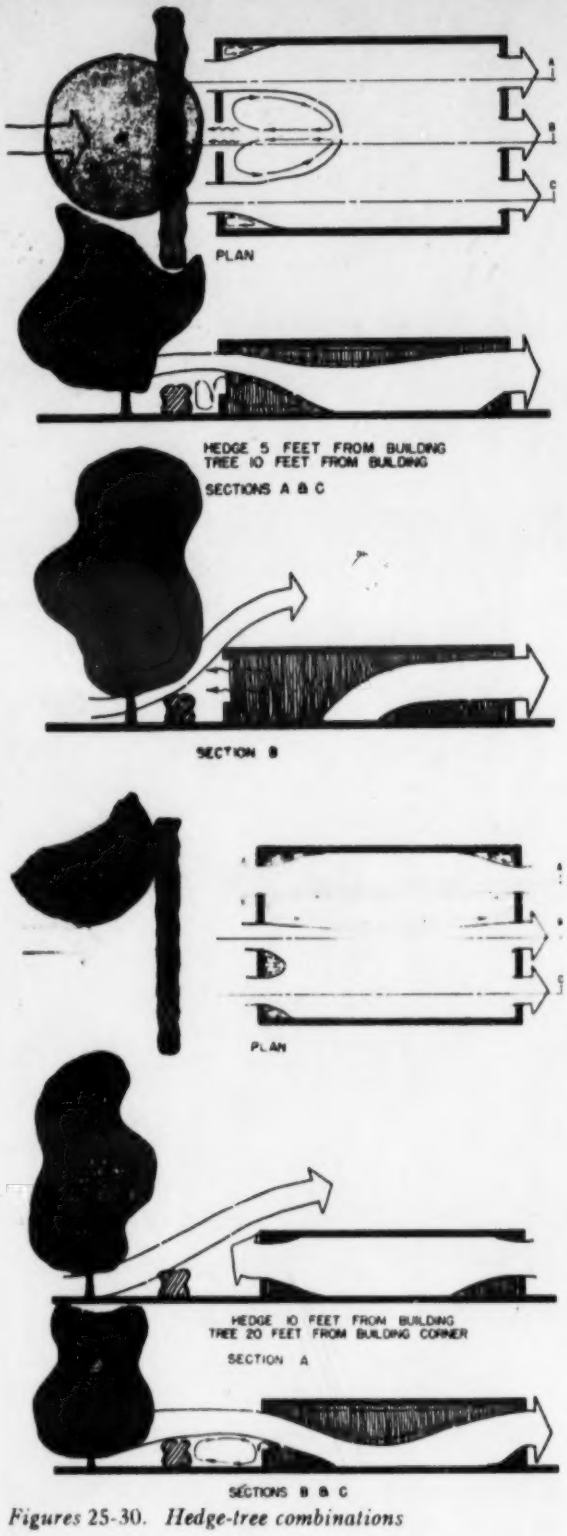




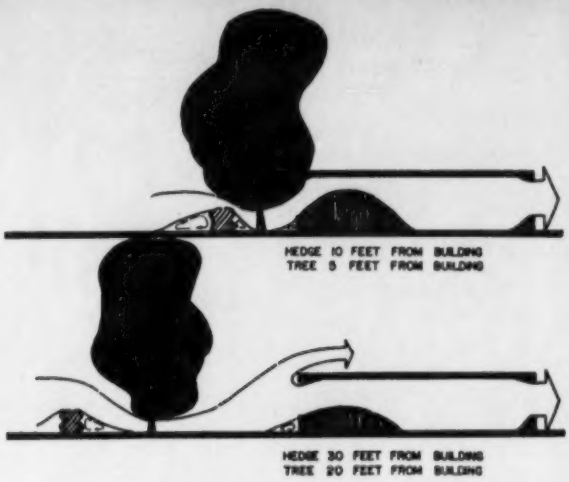




Figures 19-24. *Hedge-tree combinations*



Figures 25-30. *Hedge-tree combinations*



Figures 31-32. *Hedge-tree combinations*

Full-scale vs. Model Tests of Isolated Trees

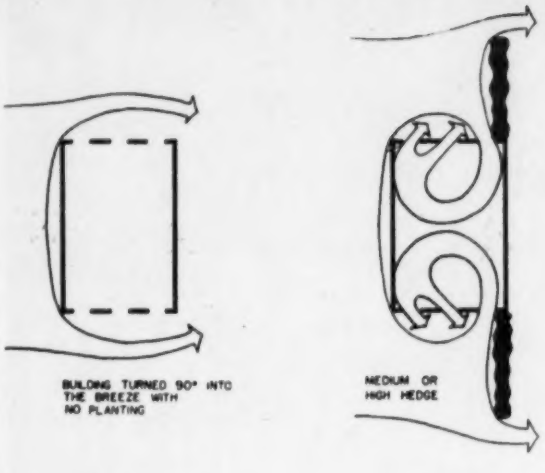
Figure 44 shows a typical testing arrangement. The station points were established at horizontal intervals of 25 feet from the center of the tree, 75 feet being the greatest distance tested. In most instances, air speeds were recorded at one-foot vertical interval to a height of seven feet for each station. Three readings of two-minute duration were taken simultaneously with readings at a common reference point R-5, which was considered as representing 100 per cent of the breeze. The readings at the other points represent the comparative speeds in terms of per cent of their respective reference point (R-5) readings.

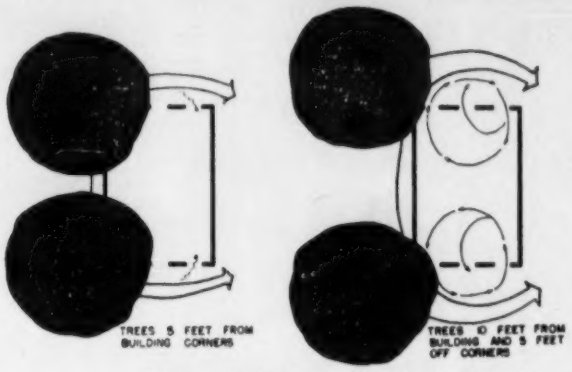
The trees which have been tested to date are shown in Figures 45, 46, and 47.

On Tree No. 1 (Figure 45) and Tree No. 2 (Figure 46) the testing was carried to a seven-foot height inasmuch as the space from the earth's surface to seven feet above it might be considered the primary human living zone. The testing for Tree No. 2 was done twice. Figure 46 shows the result of the second test, which was virtually the same as the first. The photograph of Tree No. 2 (Figure 46) shows the testing equipment in place.

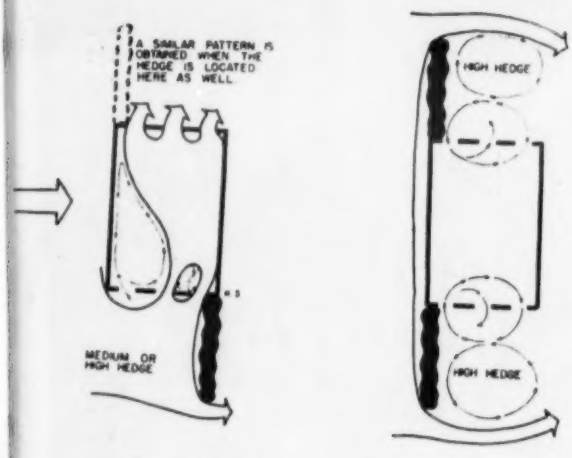
Tree No. 3 (Figure 47) was tested to a height of thirty feet above the ground or approximately six feet above the top of the tree. This test was done with the intent to verify further the air-flow pattern observed in the model tests. The photograph of Tree No. 3 also shows the testing equipment in place. The mast is an aluminum television tower which was light enough to be handled with ease.

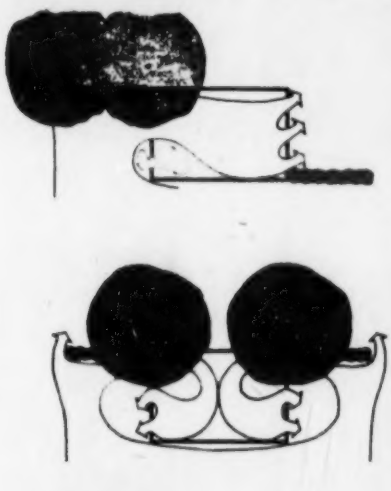
Figure 48 compares the air speeds for stations at common heights and equidistant from the tree on the lee and

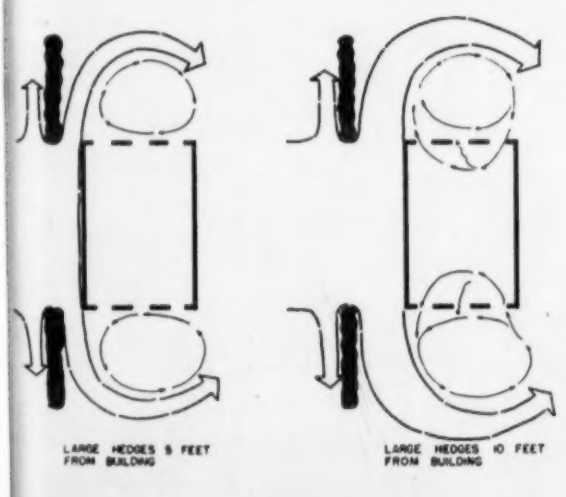


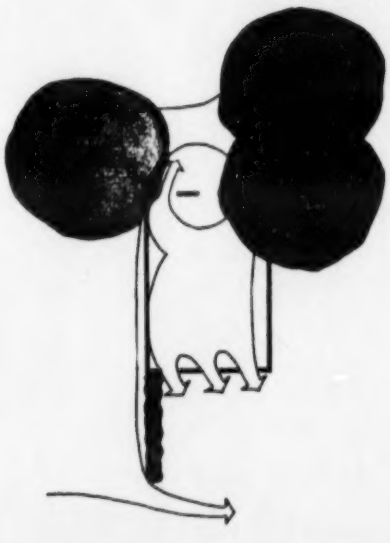


Figures 39-40. *Tree-building combinations*









Figures 33-38. *Hedge-building combinations*

Figures 41-43. *Tree-hedge-building combinations*

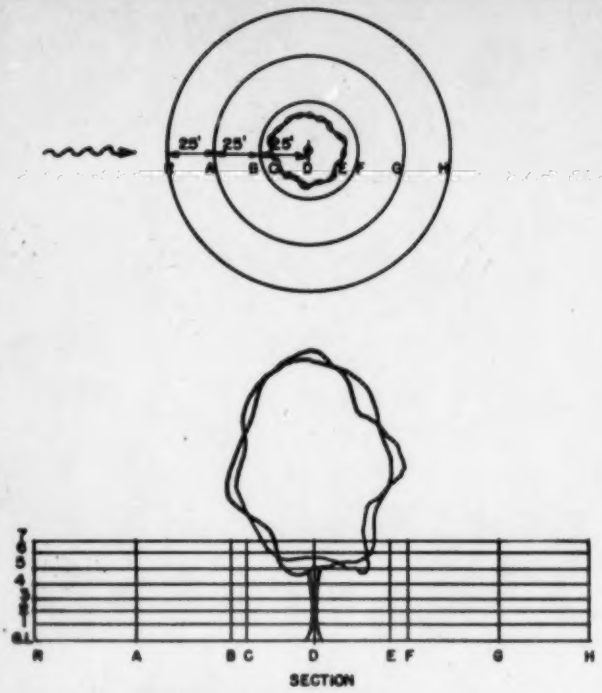


Figure 44. Typical Testing Procedure

Tree No. 1

Figure 45

PROFILE IN FIGURE 45—POINTS OF GREATEST SPEEDS

STATION		R	A	B	C	D	E	F	G
HEIGHT ABOVE GROUND	7'-0"	107.1	104.7	99.0	65.3	42.4	49.6	54.7	99.1
	6'-0"	100.8	87.7	103.1	58.6	54.5	60.1	81.1	79.0
	5'-0"	100.0	86.6	102.8	94.4	84.3	69.7	101.8	89.0
	4'-0"	92.4	85.2	85.9	110.7	113.9	81.2	67.6	78.9
	3'-0"	80.3	84.7	77.5	113.0	110.3	81.7	56.5	75.0
	2'-0"	70.4	65.3	74.1	93.0	100.1	95.0	52.2	57.1
	1'-0"	57.9	47.4	55.9	85.2	70.6	69.4	36.9	58.7

Speeds in per cent of respective reference point (R-5) readings.

windward sides. Thus for Tree No. 3, E at the edge of the foliage mass on the lee side is compared at C at the edge of the foliage on the windward side, etc. The averages for the heights 7 feet through 20 feet are significant inasmuch as the greatest foliage mass of the tree occurred through that area.

Figure 49 shows the results of testing the air speeds about a "landscape moss" model (built to a scale of $\frac{1}{2}$ inch = 1 foot) by following the same procedure used in the field tests. It further confirms the reliability of using model materials for landscape testing purposes.

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[2] Smith, E. G. The feasibility of using models for predetermining natural ventilation. College Station, Texas, Texas Engineering Experiment Station, 1951. 25 pp. (Research report 26.)

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[4] Bates, Carlos G. The windbreak as a farm asset. Washington, Government Printing Office, 1924. 15 pp. (Farmers' bulletin no. 1405.)

Tree No. 2

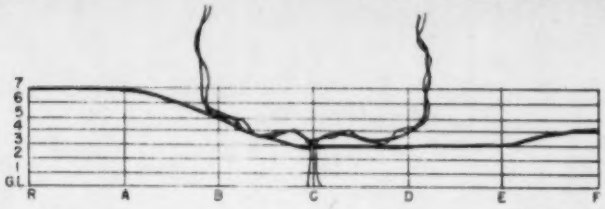

Figure 46

[6] Bates, Carlos G. Windbreaks: their influence and value. Washington, Government Printing Office, 1911. 110 pp. (U. S. Forest Service bulletin 86.)

[7] Smith, E. G., B. H. Reed, and H. D. Hodges. The measurement of low air speeds by the use of titanium tetrachloride. College Station, Texas, Texas Engineering Experiment Station, 1951. 22 pp. (Research report 25.)

PROFILE IN FIGURE 46—POINTS OF GREATEST SPEEDS

HEIGHT ABOVE GROUND	STATION R	A	B	C	D	E	F
7′-1″	116.5	108.0	92.4	71.7	33.1	57.9	64.1
6′-0″	107.6	100.7	86.5	79.5	47.5	57.1	64.2
5′-0″	100.0	93.4	92.5	95.1	52.6	67.7	68.9
4′-0″	100.4	85.0	63.6	96.9	79.4	69.9	73.7
3′-0″	84.5	80.5	47.9	118.0	97.1	75.4	48.8
2′-0″	76.1	50.9	49.0	106.2	75.9	68.9	37.2
1′-0″	53.3	48.3	43.8	86.5	61.8	28.6	55.4

Speeds in per cent of respective reference point (R-5) readings.

Tree No. 3

[7] Geiger, Rudolf. The climate near the ground. Cambridge, Mass., Harvard University Press, 1950. 482 pp.

[8] Landsberg, Helmut. Physical climatology. State College, Pa., Pennsylvania State College, School of Mineral Industries, 1942. 283 pp.

Figure 47

PROFILE IN FIGURE 47—POINTS OF GREATEST SPEEDS

HEIGHT ABOVE GROUND	STATION R	A	B	C	D	E	F	G	H
30′-0″	132.5	136.0	127.0	123.6	130.7	139.9	130.3	118.9	130.8
25′-0″	121.9	122.8	132.5	123.1	128.8	97.3	123.3	122.1	121.0
20′-0″	127.6	125.4	125.5	123.3	97.6	69.0	102.0	88.2	126.6
15′-0″	113.4	113.4	116.8	116.3	74.9	64.8	52.3	68.0	99.4
10′-0″	105.8	105.6	103.8	84.3	43.2	45.6	57.4	73.6	100.6
7′-0″	101.8	101.0	100.7	88.7	80.3	47.5	48.2	80.2	93.1

Speeds in per cent of respective reference point (R-5) readings.

PERCENTAGE OF LEE TO WINDWARD SPEEDS FOR CORRESPONDING STATIONS, TREE NO. 3

DISTANCE FR. TREE CENTER		75′	50′	25′	EDGE, FOLIAGE MASS
	PERCENTAGE OF LEE TO WINDWARD STATIONS	H to R	G to A	F to B	E to C
HEIGHT ABOVE GROUND	30′	98.7	87.4	102.7	113.2
	25′	99.3	99.5	93.0	79.0
	20′	99.3	70.3	81.2	56.0
	15′	87.3	60.0	44.8	55.7
	10′	95.0	69.7	55.3	54.2
	7′	91.5	69.4	47.8	53.5
	AV. FOR 7-20′ HT.	93.2	67.0	57.3	54.7

Figure 48

[9] Thompson, F. L., W. C. Peck, and A. P. Beard. Air conditions close to the ground and the effect on airplane landing. (*In* U. S. National Advisory Committee for Aeronautics. Twentieth annual report, 1934.) Washington, Government Printing Office, 1934, pp. 271-283.

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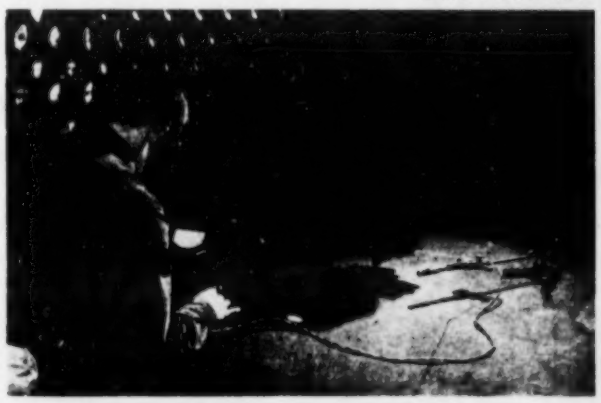
PROFILE IN FIGURE 49—POINTS OF GREATEST SPEEDS

STATION		R	A	B	C	D	E	F
HEIGHT ABOVE GROUND	7′-0″	96.4	94.2	86.0	24.0	26.6	36.0	40.0
	6′-0″	102.3	97.6	89.3	32.5	34.6	40.0	42.6
	5′-0″	100.0	92.0	87.0	48.2	44.0	45.3	40.0
	4′-0″	95.4	89.3	80.0	65.8	53.3	46.6	37.3
	3′-0″	102.3	84.7	74.0	82.4	60.0	42.6	40.0
	2′-0″	96.4	84.7	74.0	89.3	65.2	42.6	40.0
	1′-0″	82.4	70.7	58.8	82.4	57.3	34.6	26.6

Speeds in per cent of respective reference point (R-5) readings.

Variety	TREE NO. 1 Quercus stellata	TREE NO. 2 Q. stellata	TREE NO. 3 Sapindus drummondi
Height	35 ft.	45 ft.	24 ft.
Spread	30 ft.	60 ft.	22 ft.
Caliper	18 in.	30 in.	6 in.
Condition	Good	Good	Good
Branching	5′ ht.	4-5′ ht.	3-4′ ht.

Figure 49

Moss Tree Model